National Advisory Committee for Aeronautics

Research Abstracts

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CURRENT NACA REPORTS

NACA TN 2792

DIRECT-READING DESIGN CHARTS FOR 24S-T3 ALUMINUM-ALLOY FLAT COMPRESSION PANELS HAVING LONGITUDINAL FORMED HAT-SECTION STIFFENERS AND COMPARISONS WITH PANELS HAVING Z-SECTION STIFFENERS. William A. Hickman and Norris F. Dow. March 1953. 71p. photos., diagrs., 8 tabs. (NACA TN 2792)

Direct-reading design charts are presented for the determination of the stress and proportions of 24S-T3 aluminum-alloy flat compression panels having longitudinal formed hat-section stiffeners, for given values of intensity of loading, skin thickness, and effective length. Hat- and Z-stiffened panels are compared as compression panels and as the covers of box beams.

NACA TN 2889

ESTIMATION OF HYDRODYNAMIC IMPACT LOADS AND PRESSURE DISTRIBUTIONS ON BODIES APPROXIMATING ELLIPTICAL CYLINDERS WITH SPECIAL REFERENCE TO WATER LANDINGS OF HELICOPTERS. Emanuel Schnitzer and Melvin E. Hathaway. April 1953. 31p. diagrs. (NACA TN 2889)

An approximate method for computing water loads and pressure distributions of lightly loaded elliptical cylinders during oblique water impacts is presented. The method, of special interest for the case of water landings of helicopters, makes use of theory developed and checked for landing impacts of V-bottom seaplanes. Comparisons of results computed by this method with limited experimental data obtained during drops of a circular cylinder at 0° trim and 90° flight-path angle show rough agreement. A detailed computational procedure is included as an appendix.

NACA TN 2905

A RAPID METHOD FOR USE IN DESIGN OF TURBINES WITHIN SPECIFIED AERODYNAMIC LIMITS. Richard H. Cavicchi and Robert E. English. April 1953. 72p. diagrs., 2 tabs. (NACA TN 2905)

Basic thermodynamic relations were applied to axial-flow turbine designs for which specified aerodynamic limits were set in order to evolve a rapid method of determining turbine velocity diagrams. The method is presented in both chart and tabular form. Illustrative examples show the manner of selecting the number of turbine stages, the optimum work division between or among the stages, and the proximity of the staging operation to the aerodynamic limits.

NACA TN 2916

EFFECT OF THERMAL PROPERTIES ON LAMINAR-BOUNDARY-LAYER CHARACTERISTICS. E. B. Klunker and F. Edward McLean. March 1953. 29p. diagrs. (NACA TN 2916)

An iteration method is presented for solving the laminar-boundary-layer equations for compressible flow in the absence of a pressure gradient wherein the temperature variation of all the fluid thermal properties is considered. Friction and heat-transfer characteristics have been calculated for a stream temperature of -67° F for Mach numbers from 1 to 10 with the use of values of the heat capacity, conductivity, and viscosity determined from experiment. Consideration of the temperature variation of all the fluid thermal properties causes the recovery factor to decrease substantially with increasing Mach number. Moreover, the heat-transfer rate is found to be proportional to the difference between an effective enthalpy, which is a function of both the surface temperature and stream Mach number, and the surface enthalpy. In contrast, the heat-transfer rate is proportional to the difference between the recovery enthalpy and the surface enthalpy for solutions which employ a constant Prandtl number. The calculated skin friction and heat-transfer rates based upon the use of the Sutherland equation for viscosity and a Prandtl number of 0.75, however, are in excellent agreement with the results of the present analysis.

NACA TN 2919

THE ASYMMETRIC ADJUSTABLE SUPERSONIC NOZZLE FOR WIND-TUNNEL APPLICATION. H. Julian Allen. March 1953. 30p. diagrs., photos., 2 tabs. (NACA TN 2919. Formerly RM A8E17)

An asymmetric adjustable nozzle for supersonic wind-tunnel application which permits continuous adjustment of the test-section Mach number is described. The characteristics of this nozzle are compared with the more conventional supersonic tunnel nozzles.

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NACA TN 2920

INTERIM REPORT ON A FATIGUE INVESTIGATION OF A FULL-SCALE TRANSPORT AIRCRAFT WING STRUCTURE. M. James McGuigan, Jr. April 1953. 36p. photos., diagrs., 2 tabs. (NACA TN 2920)

Results are presented of constant-level fatigue tests conducted on several full-scale C-46 "Commando" airplane wings at a level of 1 ± 0.625g or about 22 ± 14 percent of the design ultimate load factor. The average lifetime for the 34 fatigue failures that occurred was about 200,000 cycles. The spread in lifetime for all failures was 4.4 to 1.0, whereas for failures repeatedly occurring at the same location it was as small as 1.2 to 1.0. Effective stress concentration factors were calculated for all failures and indicated a value of about 4.0 for an inspection cutout and 2.3 for a riveted tension joint. During the tests no change was noted in either the natural frequency or damping characteristics of the test specimens prior to the development of a fatigue crack. When a crack did occur, its rate of growth was rather slow until about 5 to 9 percent of the tension material had failed, after which the rate of crack growth increased rapidly.

NACA TN 2921

THE AERODYNAMIC DESIGN AND CALIBRATION OF AN ASYMMETRIC VARIABLE MACH NUMBER NOZZLE WITH A SLIDING BLOCK FOR THE MACH NUMBER RANGE 1.27 TO 2.75. Paige B. Burbank and Robert W. Byrne. April 1953. 37p. photos., diagrs., 5 tabs. (NACA TN 2921. Formerly RM L50L15)

A method of designing as asymmetric, fixed geometry, variable Mach number nozzle has been developed by using the method of characteristics. A small nozzle conforming to the analytically determined ordinates was constructed and calibrated over a range of Mach numbers extending from 1.27 to 2.75. The results show the variation in Mach number to be ±0.02 or less and in the flow direction to be ±0.2° within the test section. The range of Mach numbers from 1.27 to 2.75 was obtained by translating the lower block in a straight line parallel to the test-section center line for a distance of 2.17 test-section heights.

NACA TN 2922

THE DESIGN OF VARIABLE MACH NUMBER ASYMMETRIC SUPERSONIC NOZZLES BY TWO PROCEDURES EMPLOYING INCLINED AND CURVED SONIC LINES. Clarence A. Syvertson and Raymond C. Savin. March 1953. 35p. diagrs., tab. (NACA TN 2922)

Two procedures are developed for designing asymmetric supersonic nozzles for which the calculated exit flow is essentially uniform over a range of Mach numbers. One procedure is applicable at Mach numbers below approximately 3; the other procedure is used for designs at Mach numbers exceeding 3.

NACA RM E53B17

ANALYSIS OF HEAT TRANSFER AND FLUID FRICTION FOR FULLY DEVELOPED TURBULENT FLOW OF SUPERCRITICAL WATER WITH VARIABLE FLUID PROPERTIES IN A SMOOTH TUBE. Robert G. Deissler and Maynard F. Taylor. April 1953. 29p. diagrs. (NACA RM E53B17)

A previous analysis of turbulent flow and heat transfer for air with variable properties flowing in smooth tubes is generalized in order to make it applicable to supercritical water. The generalization is necessary because all the pertinent properties of supercritical water vary markedly with temperature. Calculated velocity and temperature distributions, as well as relations among Nusselt number, Reynolds number, and friction factor, are presented. The effect of variation of fluid properties across the tube on the Nusselt number and friction factor correlations can be eliminated by evaluating the properties at a reference temperature which is a function of both the wall temperature and the ratio of wall-to-bulk temperatures.

NACA RM L53A09

LANGLEY FULL-SCALE-TUNNEL TESTS OF THE CUSTER CHANNEL WING AIRPLANE. Jerome Pasamanick. April 1953. 57p. diagrs., photos., tab. (NACA RM L53A09)

An investigation has been made in the Langley full-scale tunnel to determine the lift characteristics and some of the stability and control characteristics of an experimental Custer Channel Wing airplane at zero airspeed and over the low airspeed range. Comparison is made of the airplane static lift characteristics as obtained in the absence of and in the presence of a ground effect with and without the horizontal tail surfaces. An evaluation of the flow field about the channel-propeller combination is included.

BRITISH REPORTS

N-11516A *

Aeronautical Research Council (Gt. Brit.) LIST OF CURRENT PAPERS. (NOS. 51-100) August 1952. 5p. (ARC CP 100)

This report presents a list of CP's (Nos. 51-100) published by the Aeronautical Research Council.

N-21551*

Aeronautical Research Council (Gt. Brit.)
THE NATURAL FREQUENCIES OF VIBRATION OF PRISMATIC BLADES WITH PARTICULAR REFERENCE TO A 12-STAGE TURBINE. R. Chaplin. 1952. 25p. diagrs., 3 tabs. (ARC CP 95)

The natural frequencies of vibration of the blading of a 12 stage, 3000 rpm turbine have been measured and compared with the values obtained by calculation. In the calculations for the flexural modes, corrections have been introduced for shear and rotary inertia. An empirical correction is used for the influence of the increase in torsional stiffness, due to the platform, on the frequencies of torsional vibration. The agreement of measured and computed frequencies is sufficient for the purpose of computing critical speeds up to a frequency of five kilocycles per second above which limit the discrepancy increases with the order of the mode.

N-21552*

Aeronautical Research Council (Gt. Brit.)
GRAPHICAL SOLUTION OF MULTHOPP'S EQUATIONS FOR THE LIFT DISTRIBUTION OF WINGS. F. Vandrey. 1952. 8p. diagrs. (ARC CP 96)

A simple graphical method is described facilitating the determination of the lift distribution of wings. The basis is Multhopp's method of replacing approximately the integro-differential equation for the circulation by a finite system of linear equations which give the values of the circulation at certain fixed points along the span. The values of the unknown circulations are represented by scales in a set of diagrams for the equations. The multiplication of the approximate values of the unknowns and the constant coefficients of the equations is effected by auxiliary scales in the diagrams. The corrections of the approximate values are transferred from the auxiliary scales to the main scales by a pair of dividers. The lift distribution of a rectangular wing is determined as a practical example.

N-21553*

Aeronautical Research Council (Gt. Brit.)
FLUID DYNAMIC NOTATION IN CURRENT USE AT N.G.T.E. S. Gray. 1952. 26p. diagrs. (ARC CP 97)

This memorandum records and defines the current system of notation which is in general use, at the National Gas Turbine Establishment, for work on axial flow compressors and cascade investigations in general, and which is being applied to some extent to the work on turbines. Heat transfer and supersonic flow aspects and other specialized treatments are excluded. Detailed definitions and explanations are given in classified lists, illustrated by figures, and alphabetical and numerical lists of the symbols, suffixes and indices are included.

N-21554*

Aeronautical Research Council (Gt. Brit.)
SWEPT-WING LOADING. A CRITICAL COMPARISON OF FOUR SUBSONIC VORTEX SHEET THEORIES. H. C. Garner. FOREWORD. L. W. Bryant. 1952. 61p. diagrs., 17 tabs. (ARC CP 102)

From a systematic series of calculations of swept-wing loading the writer has formed an opinion of the accuracy and most useful application of vortex lattice theory and the vortex sheet theories of Weissinger, Multhopp and Küchemann. The results provide a general picture of the effect of sweep and compressibility on lift slope and aerodynamic center.

N-21555*

Aeronautical Research Council (Gt. Brit.)
SOME EFFECTS OF REYNOLDS NUMBER ON A CAMBERED WING AT HIGH SUBSONIC MACH NUMBERS. H. E. Gamble. 1952. 34p. photos., diagrs., 2 tabs. (ARC CP 103)

An untapered, sweptback wing of aspect ratio 4, sweepback 25° and section 12-percent thick (RAE 104 with 1-percent camber, a = 0.6) was tested in the RAE high-speed tunnel. The pressure distribution was measured at the midsemispan section at various Mach numbers up to 0.88 at Reynolds numbers of 0.8, 1.8 and 3.5×10^6. There are considerable differences in the shapes of the pressure distributions at the three Reynolds numbers, although the boundary layer was laminar back to about 70-percent of the chord in all cases. At the highest Reynolds number, the suctions on the upper surface at high Mach numbers increase from the leading-edge of the wing right up to about 50 percent or 60 percent of the chord, while at the lowest Reynolds number they remain almost constant from about 30 percent to about 60 percent of the chord. This flat-topped pressure distribution, which is associated with a λ-type shock wave, results in lower lift coefficients and higher pitching-moment coefficients than those obtained at higher Reynolds number. Brief experiments, with transition provoked near the leading edge, indicate that the shape of the pressure distribution at $R = 0.8 \times 10^6$ is then something similar to that obtained at $R = 3.5 \times 10^6$ with transition free and at about 65 percent chord. It appears however, that inducing early transition artificially at higher Reynolds numbers can seriously alter the pressure distribution at high speed by causing a forward movement of the shock wave and a separation aft of it.

N-21556*

Aeronautical Research Council (Gt. Brit.)
A FROST POINT HYGROMETER FOR SUPERSONIC WIND TUNNELS. D. Beastall and A. Winyard. 1953. 8p. diagrs. (ARC CP 106)

This note describes a frost point hygrometer suitable for measuring the water vapor content of the air in supersonic wind tunnels at any stagnation pressure

within their present range of operation. It uses CO_2 as a coolant and is economical in construction and operation.

N-21557 *

Aeronautical Research Council (Gt. Brit.)
THE EFFECT OF ENDPLATES ON SWEPT WINGS. D. Küchemann and D. J. Kettle. 1952. 23p. diagrs. (ARC CP 104)

Existing methods of calculating the effect of endplates on straight wings are modified so as to apply to swept wings. The changes in over-all lift and drag, and also the spanwise distribution of the additional load, can be calculated. The theoretical results are compared with experimental results obtained on swept wings, including new measurements of lift, drag and pitching moment, made on an untapered 45° sweptback wing of aspect ratio 3 at low speed. The method of calculation is also extended to cover the effect of the tip vortex which is formed on wings without endplates.

N-21558 *

Aeronautical Research Council (Gt. Brit.)
THE DESIGN OF JETTISONABLE COCKPIT HOODS. I. L. Keitter. 1952. 34p. photos., diagrs. (ARC CP 105)

In the past much trouble has been experienced in the design of jettisonable cockpit hoods and even after a considerable amount of development many hoods are not really satisfactory. In order that a successful hood jettisoning mechanism can be produced it is essential that the various problems involved should be realized at the design stage. Consideration is given in this paper to the jettisoning problems involved in the design of all types of hoods and cockpit covers. Certain basic design criteria are proposed and the various methods of meeting them are discussed. Recommendations on good design practice are given where possible. With the knowledge that is at present available the design of a satisfactory orthodox hood should present no great problems, but the more advanced designs are likely to cause some difficulty.

N-21559 *

Aeronautical Research Council (Gt. Brit.)
SOME INVESTIGATIONS INTO THE DESIGN OF WIND TUNNELS WITH GAS TURBINE JET ENGINE DRIVES. H. J. Higgs. 1953. 84p. diagrs. (ARC CP 107)

The basic design of wind tunnels suitable for jet engine drives has been investigated by matching the predicted mass flows and total pressure losses of typical tunnel configurations with the estimated mass flow and total pressure rise characteristics of possible pumping systems. There are three possibilities of jet engine pumping (1) induction pumping (2) suction pumping and (3) parallel suction and induction pumping, of which induction pumping is shown to be the most favorable. Using this system a typical 5,000 lb thrust jet engine (such as a R. R. Nene II) can drive (1) a high speed subsonic tunnel of 4 ft^2 working section up to M = 1.0, (2) a supersonic tunnel of 2 ft^2 working section up to M = 1.2, (3) a supersonic tunnel of 1 ft^2 working section up to M = 1.8. For these three cases it has been assumed that humidity effects can be controlled by partial recirculation of the hot engine exhaust gases to raise the working section temperature of 60° C. In the supersonic case 60° might not be sufficient and other methods of humidity control have been discussed in relation to jet engine drives. Induction pumping readily allows multiple engine drive, that is, the above working section areas can be increased in proportion to the number of engines used.

N-21585*

Aeronautical Research Council (Gt. Brit.)
ON THE FLOW PAST A FLAT PLATE WITH UNIFORM SUCTION. B. Thwaites. 1952. 11p. diagrs., tab. (ARC R & M 2481. Formerly ARC 9391; FM 887; Perf. 113)

A new method of performing boundary-layer calculations is introduced in this paper, and is applied to the problem of finding the characteristics of uniform flow past a flat plate through which there is a constant normal velocity. An exact solution to this problem has not yet been found and it is therefore difficult to assess the accuracy of the results obtained. The results, however, are compared with those of two other methods. The new method will be applied to other problems. When the momentum eauation is being used, one obvious advantage of the method is that, in "adding" velocity profiles, the momentum thickness of each may be added to give the momentum thickness of the whole. This is not so in the usual methods of boundary-layer calculations, and great simplification is thereby obtained.

N-21586*

Aeronautical Research Council (Gt. Brit.)
NOTE ON THE MAINTENANCE OF LAMINAR-FLOW WINGS. W. E. Gray and H. Davies. 1952. 3p. (ARC R & M 2485; ARC 10,518. Formerly RAE Tech. Note Aero 1862)

The maintenance of laminar-flow wings involves: (1) the prevention of deterioration in the surface itself (for example, cracking of the paint or filler, increase in roughness or waviness, etc., whether due to weathering, stresses in flight, or accidental damage) and (2) the prevention of contamination of the surface with flies, etc. This report gives an account of experience gained at the Royal Aircraft Establishment in dealing with these problems during flight tests on the characteristics of low-drag wings.

N-21587*

Aeronautical Research Council (Gt. Brit.)
A SERIES OF LOW-DRAG AEROFOILS EMBODYING A NEW CAMBER-LINE. Ola Douglas. 1952. 19p. diagrs., tabs. (ARC R & M 2494; ARC 10,620)

A series of low-drag airfoils is displayed in this paper, which introduces a new stock type of camber line. This camber line affords several advantages: in particular, it makes it possible for any one of the parameters C_L range, ρ_L, $C_{L_{opt}}/C_{m0}$ and M_{crit} to take values appreciably higher than can be obtained by previous methods, the remaining parameters being fixed. The method of design follows that of R & M 2166 and the greater part of the work involves standardized computational processes. The design of one of the series is described in detail, and one is also compared, favorably, with a corresponding roof-top airfoil. A method is given of obtaining easily an approximate value for the lower limit of the C_L range when the upper limit is known.

N-21588*

Aeronautical Research Council (Gt. Brit.)
INVESTIGATIONS INTO THE EFFECT OF CONTINUOUS SUCTION ON LAMINAR BOUNDARY-LAYER FLOW UNDER ADVERSE PRESSURE GRADIENTS. B. Thwaites. 1952. 23p. diagrs., tab. (ARC R & M 2514. Formerly ARC 9555; FM 912)

The principal problem considered in this paper is that of the flow along a surface through which fluid is being continuously withdrawn at a constant velocity, the velocity of the stream outside the boundary layer having a constant and negative gradient. When no suction is applied Howarth has solved the flow, and the point of separation is known. With continuous suction, the ordinary methods of using the momentum equation, for example Pohlhausen's method, breakdown, and a new method is used in this paper to find the point of separation when suction of constant velocity is applied. Only partial success may be recorded in this problem, but this account of progress so far is now given in the hope that the problem may attract other workers. The new method of boundary-layer calculation used is not fully described in this paper, and will be explained with examples of its use, in a later paper. It has already been used in R & M 2481, where a particular problem was treated with great ease. The momentum equation of boundary-layer flow is also used to deduce other types of flow in which the velocity of suction or the velocity outside the boundary layer is not constant. These examples are inserted by virtue of the simplifications of method involved, by which the momentum equation may be integrated exactly; one of them is particularly applicable to the velocity distribution near the leading edge of a thin airfoil at high lift coefficient, in which a small amount of suction is sufficient to prevent the stall. There are appended some considerations of the practical applications of the continuous suction principle, and also some figures showing the quantities of fluid required to be sucked in, given for the benefit of designers who may not realize how small are the quantities of fluid sucked when separation of flow is suitably prevented. The application of continuous suction to delay the stall is stressed.

N-21589 *

Aeronautical Research Council (Gt. Brit.)
AEROFOIL THEORY OF A FLAT DELTA WING AT SUPERSONIC SPEEDS. A. Robinson. 1952. 21p. diagrs. (ARC R & M 2548; ARC 10,222. Formerly RAE Aero 2151)

Lift, drag, and pressure distribution of a triangular flat plate moving at a small incidence at supersonic speeds are given for arbitrary Mach number and aspect ratio. The values obtained for lift and drag are compared with the corresponding values obtained by strip theory. The possibility of further applications of the analysis leading up to the above results is indicated.

N-21590*

Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENTAL INVESTIGATION ON THE FLUTTER CHARACTERISTICS OF A MODEL FLYING WING. N. C. Lambourne. 1952. diagrs., photos., 6 tabs. (ARC R & M 2626. Formerly ARC 10,509; O. 655)

This report describes some preliminary experimental work that has been carried out in an attempt to gain information on the flexural-torsional flutter characteristics of flying wing types of aircraft. Tests were made with two flexible tip-to-tip models: (a) rectangular plan form and (b) cranked and tapered plan form. The method of supporting the models in the wind tunnel allowed certain bodily freedoms to be present either singly or simultaneously, and measurements were made of critical speeds and frequencies, and in a few cases the flutter motion was analyzed by means of cinematograph records. The experimental results are in no way conclusive and cannot be directly applied to full-scale problems, but they do point to some of the difficulties in the treatment of the flutter of flying wings. Further the difficulties encountered during the flutter tests themselves lead to suggested modifications in the technique of providing a model in a wind tunnel with the bodily freedoms appropriate to free flight conditions.

N-21591*

Aeronautical Research Council (Gt. Brit.)
A CRITERION FOR THE PREVENTION OF SPRING-TAB FLUTTER. A. R. Collar and G. D. Sharpe. 1952. 19p. diagrs., 3 tabs. (ARC R & M 2637; ARC 9104; ARC 9956. Formerly RAE SME 3346; SME 3378)

The present paper advances a formula which can be used as a criterion for the degree of mass balance

necessary for the avoidance of spring-tab flutter. The formula shows that if the tab is of sufficiently light construction, mass balance may not be required at all; on the other hand, the usual static balance may be inadequate for a tab of high inertia. The criterion comprehends within itself the requirement (given elsewhere) limiting the length of a mass balance arm. While the formula is based on theoretical considerations, the numerical values for the quantities to be used have been deduced from flight experience, which shows excellent correlation with the theory. Two forms for the criterion are given: a simple form suitable for general application, and a slightly elaborated form intended for application to unusually large tabs. The appendix, besides containing the main analysis, also gives consideration to certain factors which for simplicity are omitted in the main text. In particular it is shown that the "limiting length" for a balance arm may be generalized to a "limiting circle" for the position of the balance mass: the circle can often be found from simple geometrical considerations.

N-21592*

Aeronautical Research Council (Gt. Brit.)
PERFORMANCE CALCULATIONS FOR A DOUBLE-COMPOUND TURBO-JET ENGINE OF 12:1 DESIGN COMPRESSOR PRESSURE RATIO. D. H. Mallinson and W. G. E. Lewis. 1952. 29p. diagrs. (ARC R & M 2645; ARC 11,355. Formerly NGTE R. 19)

This report describes a theoretical investigation using conventional component characteristics to discover that division of work between the low and high-pressure compressors of a double-compound simple-jet gas turbine of 12:1 design pressure ratio which is likely to result in the most desirable equilibrium operation over the normal engine speed range. Having decided in favor of a pressure ratio of 3:1 in the low-pressure compressor and 4:1 in the other, a study is then made using more realistic compressor characteristics to determine the probable performance of such an engine under all flight conditions when the design maximum temperature is 900° C (1173° K). The equilibrium running conditions of the engine are investigated with special reference to the problems introduced by the double-compound type of design.

N-21593*

Aeronautical Research Council (Gt. Brit.)
COMPRESSION TESTS ON DURAL-CELLUBOARD SANDWICH PANELS. K. H. V. Britten. 1952. 18p. diagrs., photos., 5 tabs. (ARC R & M 2658; ARC 10,427. Formerly RAE Tech. Note SME 383)

Results are given of compression tests made on 56 dural-Celluboard sandwich panels with birch spruce or whitewood centers. These are compared with results from similar tests on dural-balsa sandwich and all-metal panels, and it is seen that over a range of sizes and weights considered dural-Celluboard can be equally or more efficient for carrying end loads. The birch Celluboard was more efficient than the spruce or whitewood and the thicker sandwiches, and those with thicker skins were more efficient than the thinner specimens. The maximum stress reached in the skin, 48,000 lb/sq in., was equal to the 0.1 percent tensile proof stress of the material. The birch filling had also reached its maximum compression stress, 8,000 lb/sq in. The design had therefore exploited these materials to their fullest extent.

N-21594*

Aeronautical Research Council (Gt. Brit.)
EXPERIMENTS GIVING HINGE MOMENT AND LIFT ON A NACA 0015 AEROFOIL FITTED WITH A 40 PER CENT CONTROL, WITH ESPECIAL REFERENCE TO EFFECT OF CURVATURE OF CONTROL SURFACE. A. S. Batson, J. H. Preston and J. H. Warsap. 1952. 27p. diagrs., photos., 6 tabs. (ARC R & M 2698. Formerly ARC 6666; S & C 1525)

The work described in this report may be considered a continuation of that given in part I of R & M 2008. It may be divided into two parts. The first part consists of experiments giving hinge moment and lift data on an unmodified control forming part of an NACA 0015 airfoil. For the second part similar experiments were undertaken as part of a general research into the effect on the properties of controls of curvature of control surface.

N-21595*

Aeronautical Research Council (Gt. Brit.)
TORSIONAL VIBRATION IN AIRCRAFT POWER PLANTS: METHODS OF CALCULATION. PART I. INTRODUCTION AND GENERAL COMMENTS. PART II. PRACTICAL TREATMENT OF THE GENERAL PROBLEM. PART III. PRACTICAL CALCULATIONS FOR A TYPICAL 12-CYLINDER VEE ENGINE. B. C. Carter. 1952. 63p. diagrs., tabs. (ARC R & M 2739; ARC 3519. Formerly RAE E. 3586)

The object of this report is to assist designers of aircraft power plants in avoiding harmful torisonal vibration of the crankshaft-airscrew system.

N-21596*

Aeronautical Research Council (Gt. Brit.)
DESIGN AND CALIBRATION TESTS OF A 5.5 IN. SQUARE SUPERSONIC WIND TUNNEL. J. Lukasiewicz. 1952. 36p. photos., diagrs., 4 tabs. (ARC R & M 2745; ARC 13,425. Formerly RAE Tech. Note Aero 2033, sup. 100)

The main design features of the wind tunnel are described and results are given of the investigations carried out to determine: (a) the minimum pressure ratio required to operate the wind tunnel at Mach numbers up to 3.5, and (b) the uniformity of the velocity distribution in the working section at Mach numbers of 1.57, 1.88, 2.48, 2.85, 3.25 and 3.5. It was found that the tunnel pressure recovery can

be appreciably increased by means of a contraction ("second throat") located between the working section and subsonic diffuser. All nozzles tested were designed with short throats and expansion profiles with the maximum angles of expansion for the given exit Mach number. The axial variation of Mach number over selected intervals of working section (not smaller than 5 in.) was found to be of the order of ±1.0 percent. It was found that condensation in the wind-tunnel nozzle (run with atmospheric air) has a detrimental effect on the velocity distribution in the working section, particularly at small Mach numbers.

N-21597 *

Aeronautical Research Council (Gt. Brit.)
INVESTIGATIONS ON STALLING BEHAVIOUR, RUDDER OSCILLATIONS, TAKE-OFF SWING AND FLOW ROUND NACELLES ON THE TUDOR I AIRCRAFT. D. J. Lyons. 1952. 18p. diagrs., 2 tabs. (ARC R & M 2789; ARC 11,412. Formerly RAE Aero 2237)

During the development of the Tudor I aircraft, the Royal Aircraft Establishment cooperated in the flight tests. This report summarizes the results, which are felt to be of general interest. The importance of "deep tufting" in leading to an understanding of varied aerodynamic problems has again been forcibly demonstrated; namely in showing that: (a) early buffeting of the Tudor as the stall is approached was due to a very small airleak around the leading edge of the wing root causing a breakaway of flow, the resultant wake of which hit the tailplane; (b) early wing-tip stalling was shown to be due to small malfitment of the T.K.S. de-ciers; (c) rudder "kicking" arose from flow through the hinge cutouts; (d) excessive take-off swing was due to poor rudder control as a result of the early rudder stall, and to the fact that the aircraft was stalled in the ground attitude; and (e) the inner nacelle needed considerable lengthening.

N-21598 *

Aeronautical Research Council (Gt. Brit.)
WIND-TUNNEL MEASUREMENTS OF YAWING MOMENT DUE TO YAWING (n_r) ON A 1/5.5 SCALE MODEL OF THE METEOR MARK F.III. J. G. Ross and R. C. Lock. 1952. 31p. diagrs., photos., 10 tabs. (ARC R & M 2791; ARC 10,786. Formerly RAE Aero 2199)

During recent investigations into the self-excited oscillations in yaw, experienced on Meteor aircraft, the lateral stability derivative n_r was measured in flight, and found to differ considerably during initial experiments from the theoretical estimate. A new technique was therefore devised to measure n_r in the wind-tunnel; and, with its aid, modifications were tested on a model with the object of reducing the self-excited oscillations in flight. Measurements of n_r were made over a range of Reynolds numbers, and for different periods of oscillation of the model. The final comparison of the flight and wind-tunnel tests, after certain refinements in technique of the former, and after corrections for solid friction to the latter had been made, showed that the full-scale measurement of n_r was about 10 percent less than that obtained in the tunnel. Considering the difficulties involved, this agreement may be considered as satisfactory. For the model in the standard condition, the value of n_r was about 20 percent less than the estimated figure of -0.108 at zero lift, but with dorsal fins. It was found possible, without altering the value of n_v, to increase the value of n_r to the estimated value. The "snaking" tendencies of the model, which were more pronounced at small angles of incidence, could be greatly reduced by fitting an upper dorsal fin.

MISCELLANEOUS

NACA TN 2505

Addendum No. 1 to "ON THE ATTACHED CURVED SHOCK IN FRONT OF A SHARP-NOSED AXIALLY SYMMETRICAL BODY PLACED IN A UNIFORM STREAM." S. F. Shen and C. C. Lin. October 1951.